



Silica Supported Palladium Nanoparticles for Suzuki Coupling Reactions

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Abstract

Palladium nanoparticles supported on silica has been developed as catalyst for the Suzuki coupling reaction. Preparation of this catalyst employs a single-step mixing of freshly prepared palladium nanoparticles with tetraethoxysilane, using a sol-gel approach. The synthesized catalyst was characterized using XRD, FESEM, EDS elemental analysis, and FTIR spectroscopy. Particle dispersion was characterized from the SEM, whereas EDS confirmed the presence of the constituent elements, and in addition, FTIR shows characteristic peaks of silica. The catalyst was designed to have 1 wt% and 2 wt% palladium nanoparticles. The performance test for Suzuki coupling reaction showed remarkably high turnover frequency ($12,600 \text{ h}^{-1}$) along with good yield and recyclability.

Introduction

What are Coupling Reactions

- Two hydrocarbon fragments are coupled.
- Using metal catalyst.
- Example:
 - Heck reaction
 - Negishi coupling
 - Suzuki reaction

Suzuki Coupling Reaction

- Aryl halides and phenylboronic acid coupling.
- For synthesis of important organic compounds.
 - Drugs.
 - Fine chemicals.



Recent catalysts

1	Homogeneous catalyst ✓ Synthesis of Pd(0)-complex (Difficult to make and hard to separate).
2	Heterogeneous catalyst: ✓ Palladium supported on graphene sheets (expensive).

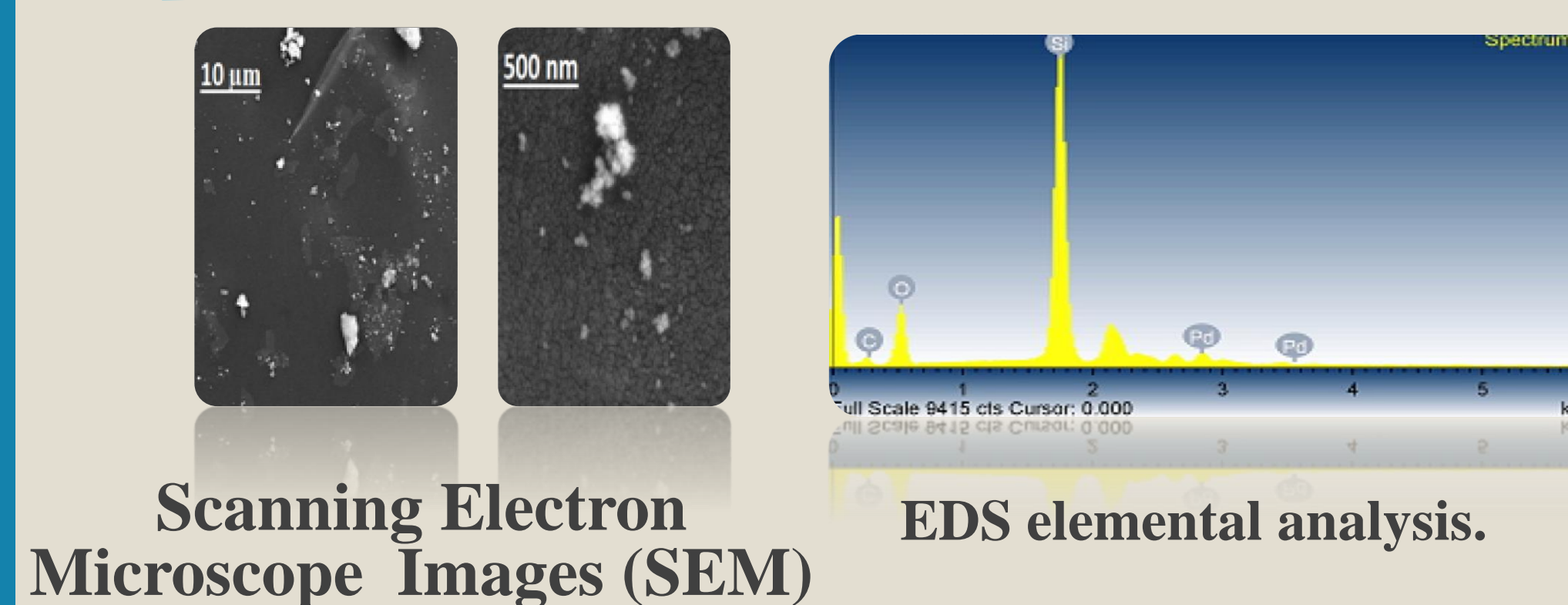
We choose silica-based catalyst:

01	Inexpensive
02	Heterogeneous catalysis
03	Easy to synthesis and separate
04	Energy efficient

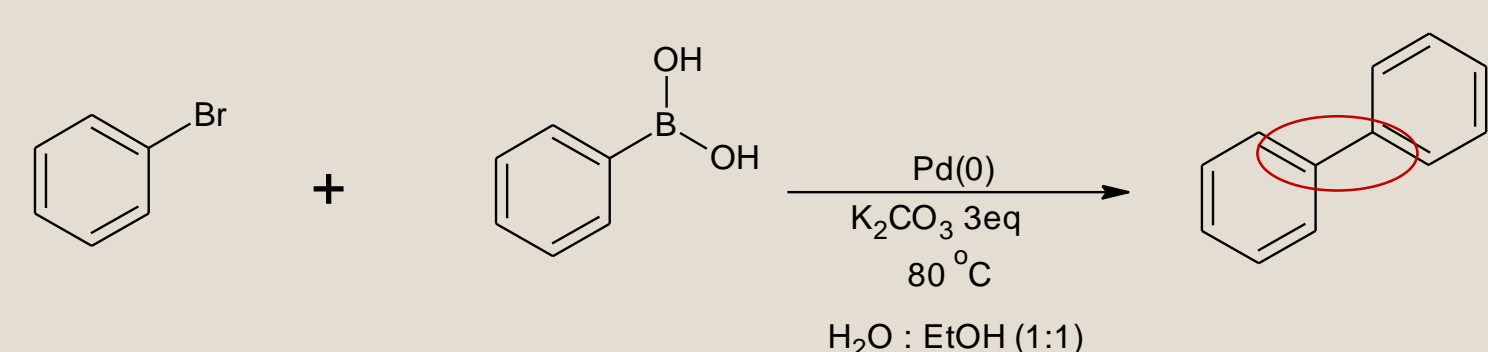
Synthesis of the Catalyst

- Prepare palladium nanoparticle.
- Support it with silica using sol-gel approach.

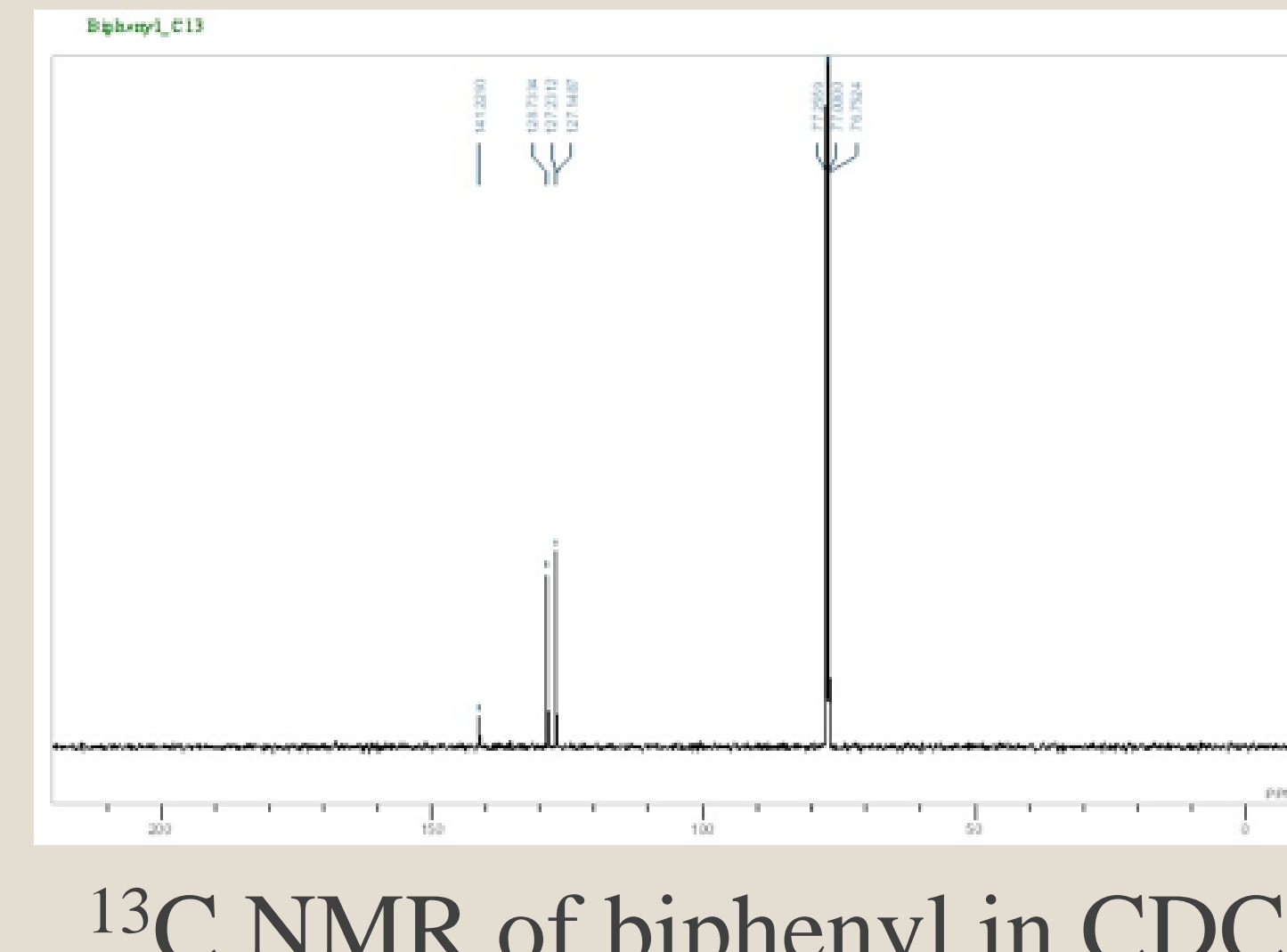
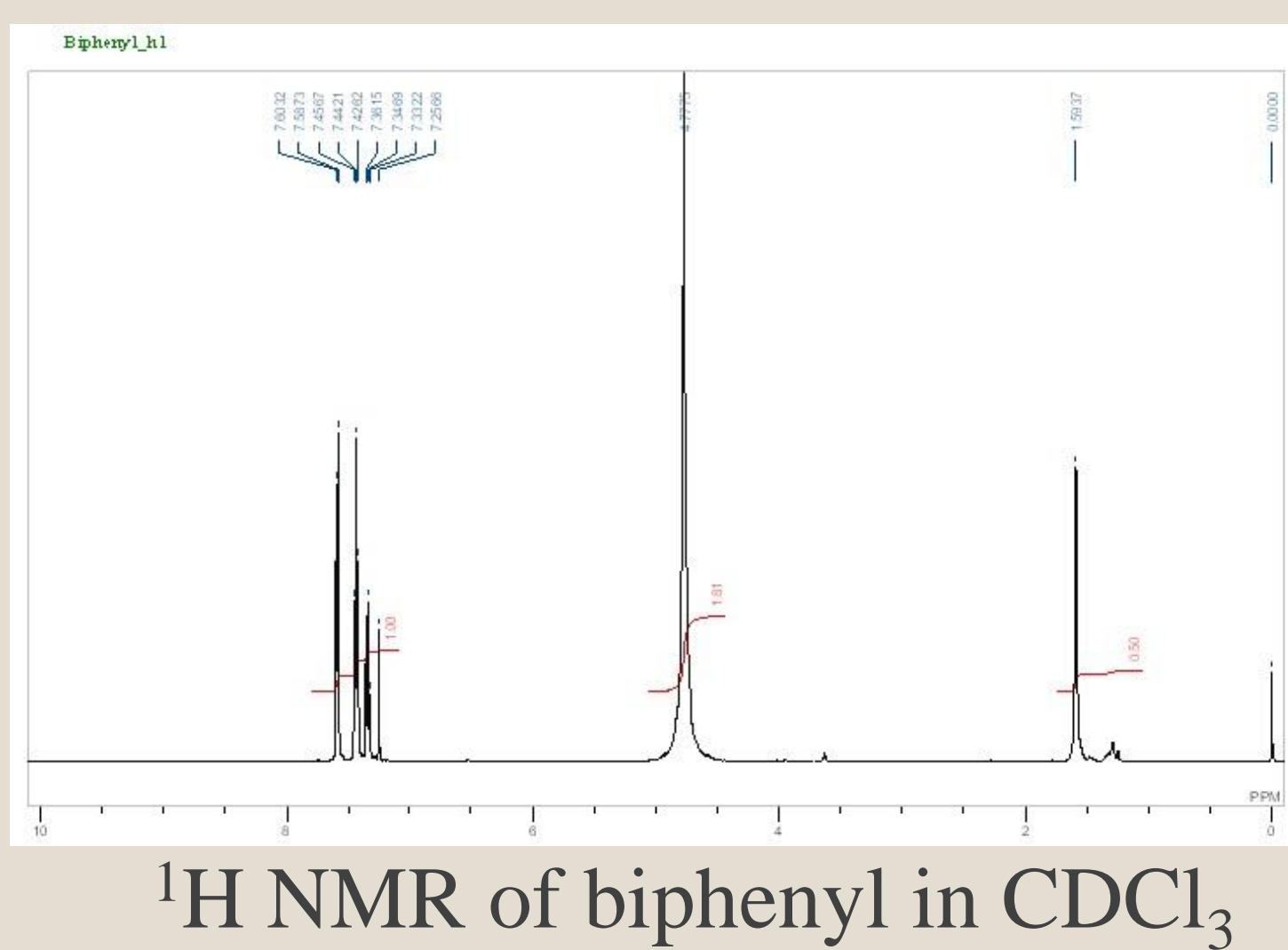
Characterization of catalyst



Catalyst's activity



1 wt% PdNP supported on silica
Yield = 75% after 10 min
TOF = $12,600 \text{ h}^{-1}$



Conclusion

- Simple and inexpensive Pd-immobilized silica catalyst was synthesized.
- The catalyst perform excellently in Suzuki coupling reaction in water and ethanol.
- Catalyst was easily separated from reaction mixture by filtering.

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